

ELECTRONICS AND COMPUTER TECHNOLOGY II

Electronics and Computer Technology II provides the opportunity for students to continue with foundational electronic concepts including circuit analysis and digital electronics modules. After completing the two additional foundational modules, student may choose to focus on one of the optional modules that can include more intense instruction, research, specialized projects, and internships. The optional modules include industrial technology, emerging electronic technologies, residential and commercial electronic communication, and automation. The content of this class is designed to provide the State of Indiana with a trained workforce in emerging technologies career pathways that will make a significant contribution to the Indiana economy. Industry certifications and additional post-secondary education are critical components of this pathway. Classroom, laboratory, and work-based experiences in the fundamental electronics concepts of circuit analysis and digital electronics as well as one of the optional modules will incorporate safety, technical writing, mathematics, and customer service.

- DOE Code: 5694
- Recommended Grade Level: Grade 12
- Recommended Prerequisites: Electronics and Computer Technology I
- Credits: 2-3 credits per semester, maximum of 6 credits
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors and Core 40 with Technical Honors diplomas
- This course is aligned with postsecondary courses for Dual Credit:
 - Vincennes University
 - ELEC 130- Digital Electronics
 - Ivy Tech
 - EECT 112- Digital Fundamentals
 - EECT 121- Electronics Circuits Analysis

Dual Credit

This course provides the opportunity for dual credit for students who meet postsecondary requirements for earning dual credit and successfully complete the dual credit requirements of this course.

Application of Content and Multiple Hour Offerings

Intensive laboratory applications are a component of this course and may be either school based or work based or a combination of the two. Work-based learning experiences should be in a closely related industry setting. Instructors shall have a standards-based training plan for students participating in work-based learning experiences. When a course is offered for multiple hours per semester, the amount of laboratory application or work-based learning needs to be increased proportionally.

Career and Technical Student Organizations (CTSOs)

Career and Technical Student Organizations are considered a powerful instructional tool when integrated into Career and Technical Education programs. They enhance the knowledge and skills students learn in a course by allowing a student to participate in a unique program of career and leadership development. Students should be encouraged to participate in SkillsUSA, the CTSO for this area.

Content Standards

Domain – Basic Safety For Electronics And Computer Technology II

Core Standard 1 Students apply and adapt basic electrical safety practices to ensure professional and governmental compliance.

Standards

- ECTII-1.1 List tools and hazards that are associated with technician activities in the workplace
- ECTII-1.2 List ladder handling, usage, and height safety rules as outlined by OSHA
- ECTII-1.3 List service vehicle safety concerns such as transporting ladders, securing equipment and materials, and providing driver screens inside the vehicle
- ECTII-1.4 Describe lockout and tagging rules for potentially unsafe electrical or mechanical hazards
- ECTII-1.5 Describe personal safety precautions for working with electrical and electronic devices
- ECTII-1.6 Describe the human physiological reactions electrical shock causes
- ECTII-1.7 List various degrees of current the human body can tolerate
- ECTII-1.8 Explain the concept of First Aid and its particular importance to workers in electric and electronic fields
- ECTII-1.9 List and explain fire safety regulations as specified by National Electrical Code (NEC) and National Fire Protection Association (NFPA) 70 – To include understanding the different classes of fires and extinguishers used to fight them
- ECTII-1.10 List fiber optics hazards to skin and eyes
- ECTII-1.11 Explain the reasons for safety in the following areas: electrical and electronic safety, electrostatic discharge (ESD), electromagnetic interference (EMI), fire safety, physical safety, fiber optics cable, magnets, CD-ROM safety and maintenance issues
- ECTII-1.12 List the safety precautions to be taken when working with diodes, transistors, thyristors, integrated circuits, optoelectronic devices, power supplies, amplifiers, operational amplifiers, oscillators, and wave-shaping circuits
- ECTII-1.13 Employ skills necessary to differentiate among investigative typologies including offenses, offenders and victims

Domain – Digital Electronics

Core Standard 2 Students analyze the workings and configurations of digital design and circuitry.

Standards

- ECTII-2.1 Compare and contrast between 1 and 0; high and low; +5 and ground; and truth and false logic levels
- ECTII-2.2 Identify and convert numbers between the decimal, binary, octal, and hexadecimal and BCD number systems
- ECTII-2.3 Identify and describe the function of AND, OR, Inverter, NAND, NOR, Buffer, Exclusive OR and Exclusive NOR gates
- ECTII-2.4 Understand the uses for logic test probes
- ECTII-2.5 Create truth tables from design specifications and logic expressions
- ECTII-2.6 Create a logic expression and truth table from an AOI circuit
- ECTII-2.7 Develop an un-simplified logic expression from a truth table

- ECTII-2.8 Explain Boolean Algebra and its use in digital circuitry
- ECTII-2.9 Simplify a logic expression using the rules and laws of Boolean Algebra including DeMorgan's
- ECTII-2.10 Simplify un-simplified logic expressions containing two, three, or four variable K-Maps
- ECTII-2.11 Compare and contrast a logic design using AOI, NAND, and NOR type combinational logic circuits
- ECTII-2.12 Determine the solution that uses the least number of ICs between AOI, NAND, and NOR type logic circuits
- ECTII-2.13 Identify the difference between a Common Cathode (CC) and Common Anode (CA) seven segment display
- ECTII-2.14 Select the correct current limiting resistor for a seven segment display
- ECTII-2.15 Design half-adders and full-adders using combinational logic gates
- ECTII-2.16 Know the various type of gate packages; SSI, MSI, LSI, and VLSI
- ECTII-2.17 Design circuits using multiplexers and de-multiplexers
- ECTII-2.18 Use the two's complement process to add and subtract binary numbers
- ECTII-2.19 Design a circuit and understand the advantages and disadvantages of using a Programmable Logic Device (PLD)
- ECTII-2.20 Describe the functions of the RS, D and JK type flip-flops
- ECTII-2.21 Know the difference between the synchronous and asynchronous inputs of a flip-flop
- ECTII-2.22 Describe the timing diagram of each type of flip-flop
- ECTII-2.23 Describe counter and register characteristics
- ECTII-2.24 Explain wave shaping circuits and explaining their purposes
- ECTII-2.25 Analyze up, down and modulus asynchronous and synchronous counters
- ECTII-2.26 Know how to design counters and registers using SSI combinational gates and MSI integrated ICs
- ECTII-2.27 Analyze flip-flop applications such as event detectors, shift registers and frequency dividers
- ECTII-2.28 Apply a programming software such as Quartus to program a VHDL device to test the operation and timing diagrams of a variety of basic logic circuits

Domain—Introduction to Computer Networking – Optional

Core Standard 3 Students compare and contrast various computer networking systems to ensure proper installation and optimum network performance.

Standards

- ECTII-3.1 Explain the function of common networking protocols
- ECTII-3.2 Identify address formats and commonly use TCP and UDP default ports
- ECTII-3.3 Identify common IPv4 and IPv6 routing protocols
- ECTII-3.4 Compare the characteristics of wireless communication standards
- ECTII-3.5 Categorize standard cable types and their properties
- ECTII-3.6 Identify common connector types
- ECTII-3.7 Identify and explain common physical network topologies
- ECTII-3.8 Categorize LAN and WAN technology types and properties

- ECTII-3.9 Configure and differentiate between common network devices
- ECTII-3.10 Identify the functions of specialized network devices
- ECTII-3.11 Explain the advanced features of a switch
- ECTII-3.12 Explain the function of each layer of the OSI model
- ECTII-3.13 Explain the different methods and rationales for network performance
- ECTII-3.14 Explain the purpose of network scanners
- ECTII-3.15 Explain the function of hardware and software security devices
- ECTII-3.16 Explain the methods of network access security and common features of a firewall
- ECTII-3.17 Explain methods of user authentication and issues that affect device security
- ECTII-3.18 Identify common security threats and mitigation techniques

Domain—Pre-Wiring the Structure – Optional

Core Standard 4 Students integrate wiring concepts into residential and commercial electronics installation procedures to ensure all installed system components work per industry specifications

Standards

- ECTII-4.1 Describe the task of roughing-in new structures, installing wall boxes, conduit, distribution boxes, speaker in-wall units, CCTV mounts, etc.
- ECTII-4.2 Explain the use of wall plates and indicate proper locations
- ECTII-4.3 Describe purposes and locations for J-Hooks and cable trays
- ECTII-4.4 Explain inductive signals and interference, their effects and precautions and separation distances for cabling
- ECTII-4.5 Outline the purposes of wiring, labeling, sizing, and all factors effecting wiring installation
- ECTII-4.6 Explain methods used to closely estimate cable requirements for individual applications
- ECTII-4.7 Formalize a termination standard for RJ-45 connections
- ECTII-4.8 Select a device to distribute audio and video throughout the house
- ECTII-4.9 Lay out wiring configuration for a multi-camera surveillance system
- ECTII-4.10 Demonstrate calculations using the Power Formula and Ohm's Law
- ECTII-4.11 Explain the purpose of electric circuit grounding and NEC rules for residences
- ECTII-4.12 Describe lightning hazards, lightning arrestors used in electronics applications and how ground blocks are used
- ECTII-4.13 Diagram a basic telephone circuit
- ECTII-4.14 Differentiate between Internet – Cable TV- Wireless Systems and B-VoIP
- ECTII-4.15 Explain bar coding and modern inventory control methods for residences
- ECTII-4.16 Explain manual, automatic, and programmable appliances control
- ECTII-4.17 Explain how energy management can control the overall load on the electrical grid
- ECTII-4.18 Describe the types of installation documents and drawings used for successful installation of low voltage systems (floor plans, RCP, elevations, schedules)
- ECTII-4.19 Explain the Divide and Conquer troubleshooting method
- ECTII-4.20 List common problems and solutions in cabling
- ECTII-4.21 Identify sources of on-line and phone technical help from product makers and suppliers
- ECTII-4.22 Explain time or event automatic control operation

- ECTII-4.23 Describe the advantages of interfacing the network with the heating, ventilation and cooling system of the home
- ECTII-4.24 Describe why and how home events data may be accessed
- ECTII-4.25 Explain how event sequences can be incorporated into a home control system and the advantages
- ECTII-4.26 Describe how programmable logic control (PLC) is utilized in home control systems

Domain—Residential Wiring - Optional

Core Standard 5 Students analyze the workings and configurations of residential electrical wiring.

Standards

- ECTII-5.1 Describe electrical symbols and conductors
- ECTII-5.2 Describe electrical wiring systems and boxes
- ECTII-5.3 Understand switches, interrupters and suppressors
- ECTII-5.4 Describe recessed lighting and ballast
- ECTII-5.5 Understand branch circuits and conductor sizing
- ECTII-5.6 Describe bedroom/master bedroom circuits
- ECTII-5.7 Describe bath, hallway, front porch, and entry circuits
- ECTII-5.8 Understand kitchen, dining area, and living room circuits
- ECTII-5.9 Describe laundry, study, rear entrance, and attic circuits
- ECTII-5.10 Describe family room and garage circuits
- ECTII-5.11 Describe workshop circuits and basement circuits
- ECTII-5.12 Describe water pump and heater circuits
- ECTII-5.13 Understand large kitchen appliance circuits
- ECTII-5.14 Understand vent fan and hydromassage circuits
- ECTII-5.15 Describe electric heating and air conditioning wiring circuits
- ECTII-5.16 Understand oil/gas heating and heat/smoke detectors
- ECTII-5.17 Describe television and telephone signal distribution systems
- ECTII-5.18 Understand entrance equipment and calculations
- ECTII-5.19 Understand pools, spa and smart house wiring
- ECTII-5.20 Understand remote control systems

Domain—Alternative Energy: Photovoltaic - Optional

Core Standard 6 Students analyze the workings and configurations of photovoltaic alternative energy systems.

- ECTII-6.1 Identify major components of a Photovoltaic System
- ECTII-6.2 Identify types of PV systems
- ECTII-6.3 Identify panel types and characteristics
- ECTII-6.4 Determine proper installation sequence for Array and BOS
- ECTII-6.5 Install basic Array and BOS components
- ECTII-6.6 Determine proper Array orientation

- ECTII-6.7 Understand basic performance characteristics
- ECTII-6.8 Understand basic systems sizing methods
- ECTII-6.9 Troubleshoot basic systems problems and installations errors
- ECTII-6.10 Understand safe working practices for: Working aloft (ladder, roof, lanyard and harness)
- ECTII-6.11 Understand safe working practices for: Working with hand and basic power tools
- ECTII-6.12 Understand safe working practices for: Eye and ear protection
- ECTII-6.13 Understand safe working practices for: Electrical safety

Domain—Alternative Energy: Small Wind Energy Generation - Optional

Core Standard 7 Students analyze the workings and configurations of small wind alternative energy systems.

- ECTII-7.1 Identify major components of a Small Wind System
- ECTII-7.2 Identify types of SW systems
- ECTII-7.3 Identify mounting and turbine types and characteristics
- ECTII-7.4 Determine proper installation for turbine types
- ECTII-7.5 Install basic small wind turbine components
- ECTII-7.6 Determine proper site location
- ECTII-7.7 Understand basic performance characteristics
- ECTII-7.8 Understand basic systems sizing methods
- ECTII-7.9 Troubleshoot basic systems problems and installation errors
- ECTII-7.10 Understand safe working practices for: Tower safety
- ECTII-7.11 Understand safe working practices for: Working aloft (ladder, roof, lanyard and harness)
- ECTII-7.12 Understand safe working practices for: Working with hand and basic power tools
- ECTII-7.13 Understand safe working practices for: Eye and ear protection
- ECTII-7.14 Understand safe working practices for: Electrical safety

Process Standards

Common Core Literacy Standards for Technical Subjects

Reading Standards for Literacy in Technical Subjects 9-10

The standards below begin at grade 9 and define what students should understand and be able to do by the end of grade 10. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

Key Ideas and Details

- 9-10.RT.1 Cite specific textual evidence to support analysis of technical texts, attending to the precise details of explanations or descriptions.
- 9-10.RT.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
- 9-10.RT.3 Follow precisely a complex multistep procedure when performing technical tasks,

attending to special cases or exceptions defined in the text.

Craft and Structure

- 9-10.RT.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific context relevant to *grades 9-10 texts and topics*.
- 9-10.RT.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).
- 9-10.RT.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

Integration of Knowledge and Idea

- 9-10.RT.7 Translate technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
- 9-10.RT.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a technical problem.
- 9-10.RT.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

Range of Reading and Level of Text Complexity

- 9-10.RT.10 By the end of grade 10, read and comprehend technical texts in the grades 9-10 text complexity band independently and proficiently

Writing Standards for Literacy in Technical Subjects 9-10

The standards below begin at grade 9 and define what students should understand and be able to do by the end of grade 10. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

Text Types and Purposes

- 9-10.WT.1 Write arguments focused on *discipline-specific content*.
- 9-10.WT.2 Write informative/explanatory texts, including technical processes.
- 9-10.WT.3 Students will not write narratives in technical subjects. *Note: Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In technical, students must be able to write precise enough descriptions of the step-by-step procedures they use in their technical work that others can replicate them and (possibly) reach the same results.*

Production and Distribution of Writing

- 9-10.WT.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- 9-10.WT.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
- 9-10.WT.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other

information and to display information flexibly and dynamically.

Research to Build and Present Knowledge

- 9-10.WT.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- 9-10.WT.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation
- 9-10.WT.9 Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

- 9-10.WT.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.